June 30, 1964 W. McCOLL 3,138,819

FLUID HEATER CLEANERS

Filed Feb. 9, 1961

6 Sheets-Sheet 1

Fig. 1.

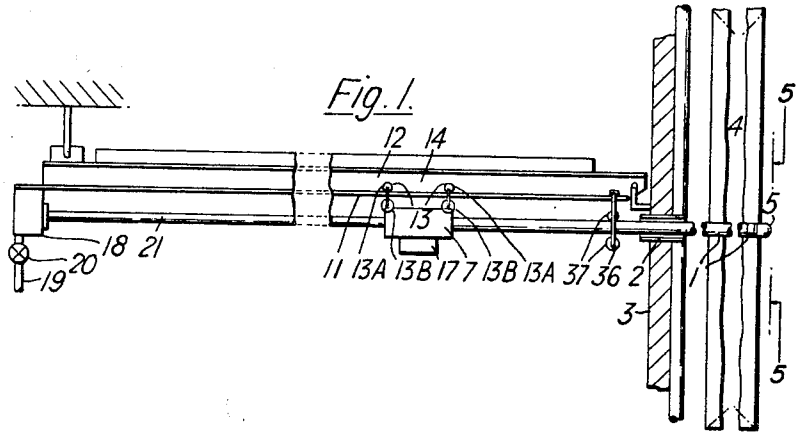


Fig. 3.

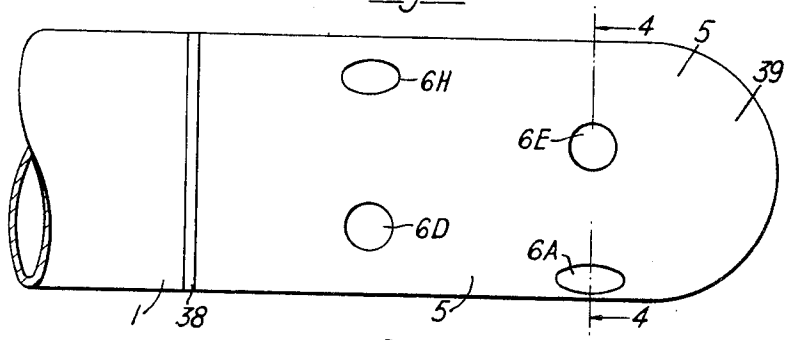


Fig. 4.

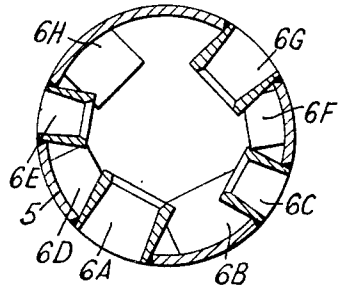
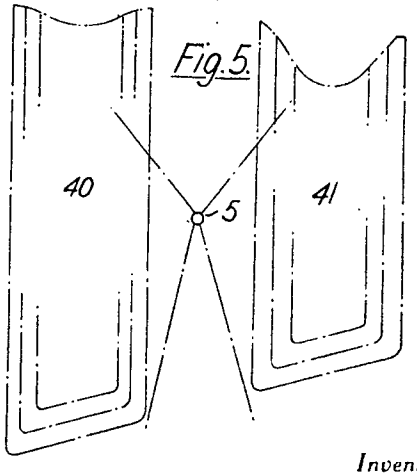


Fig. 5.



Inventor

William McColl

By

Pennie, Edmonds, Morton, Barrows & Taylor

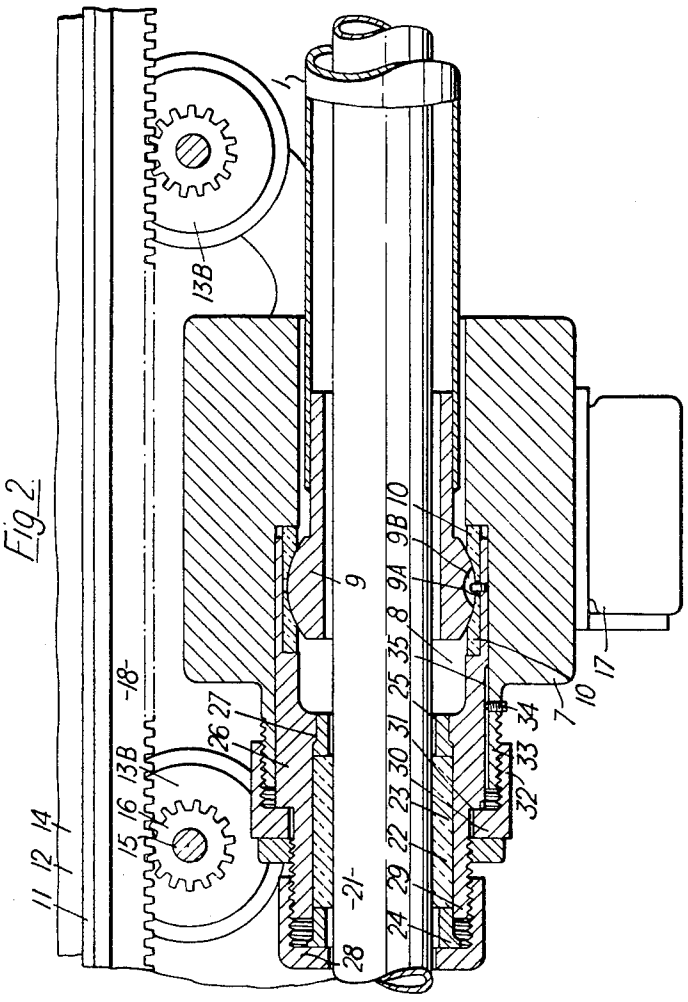
Attorneys

June 30, 1964 W. McCOLL 3,138,819

FLUID HEATER CLEANERS

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Fig. 2



Inventor
William McColl

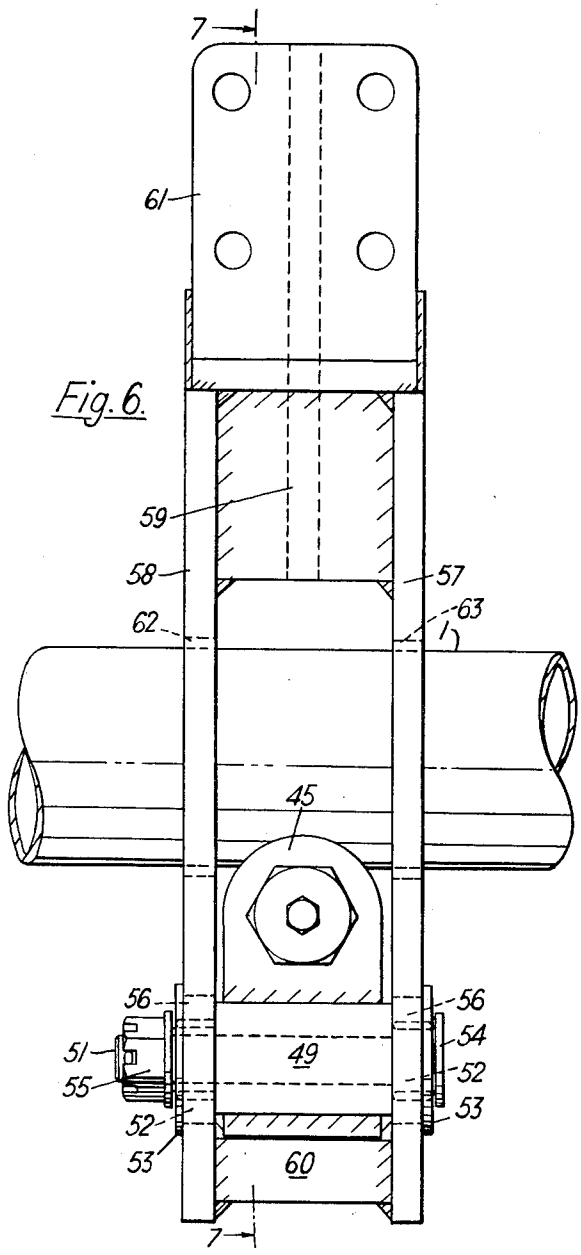
By
Pennie, Edmonds, Morton, Barrows & Taylor
Attorneys

June 30, 1964 W. McCOLL 3,138,819

FLUID HEATER CLEANERS

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Fig. 6.



Inventor
William McColl

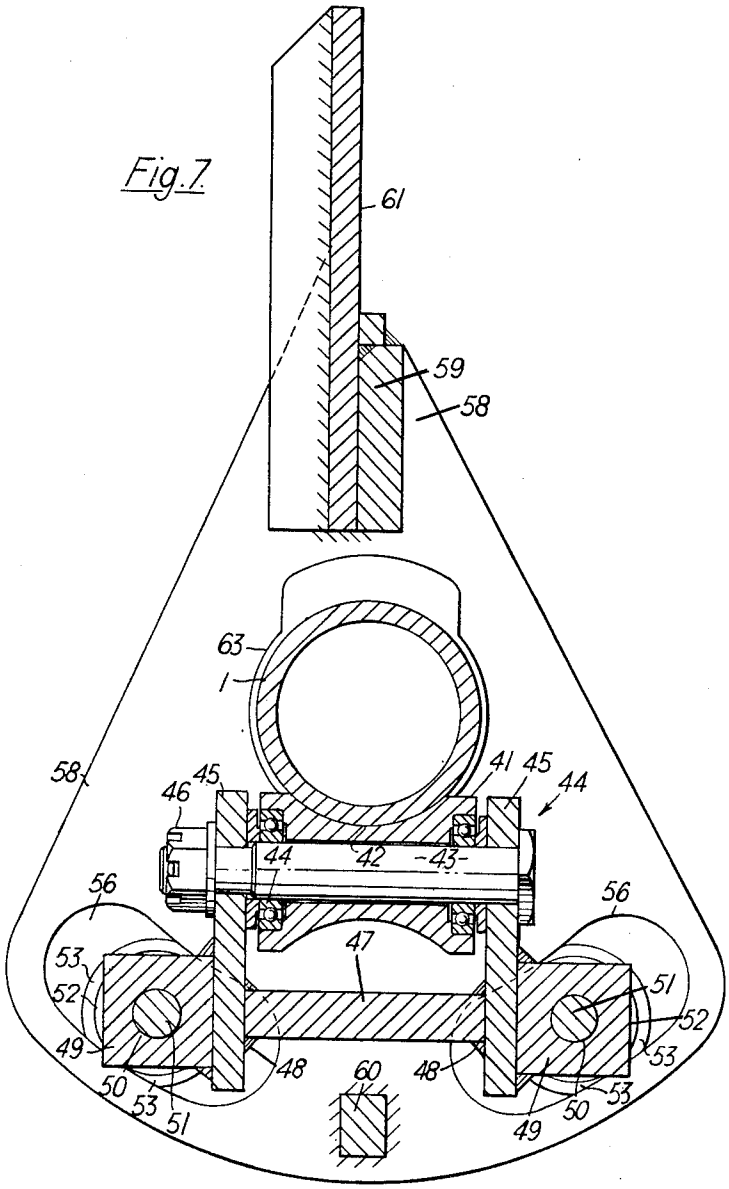
By
Pennie, Edmonds, Morton, Barrows & Taylor
Attorneys

June 30, 1964 W. McCOLL 3,138,819

FLUID HEATER CLEANERS

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Fig. 7



Inventor
William McColl

By
Pennie, Edmonds, Morton, Barrows & Taylor
Attorneys

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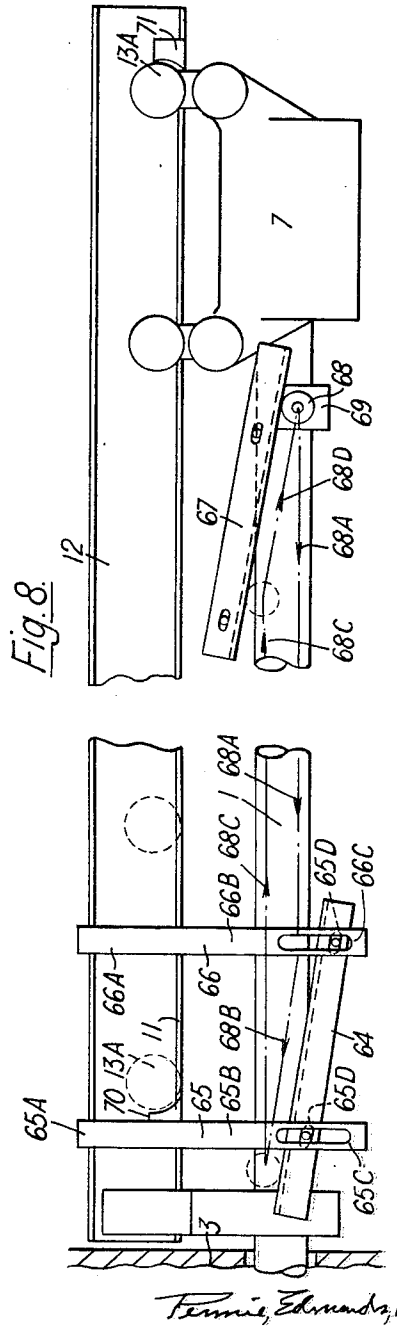


Fig. 8

Inventor
William McColl
By
Pennie, Edmonds, Morton, Barrows & Taylor
Attorneys

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FLUID HEATER CLEANERS

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Fig. 9

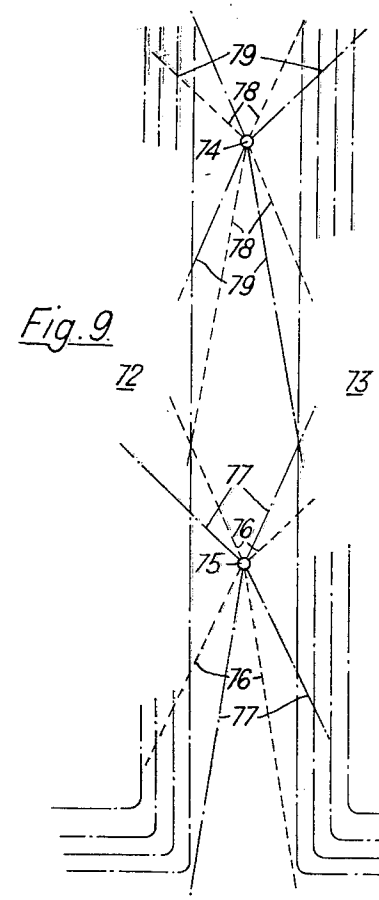
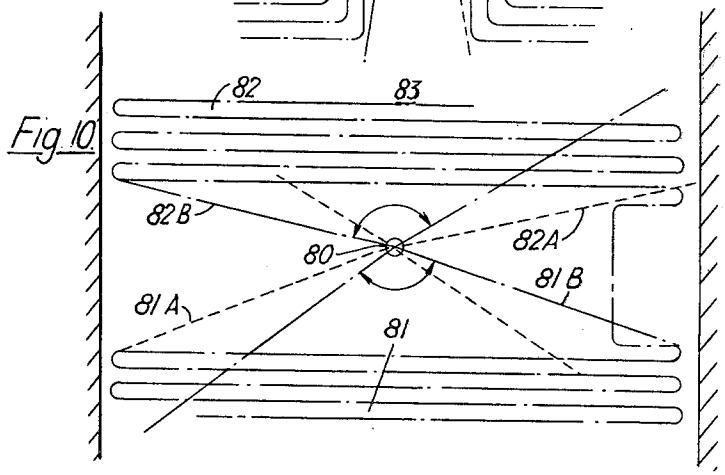


Fig. 10



Inventor

William McColl

By Fennie, Edmonds, Morton, Barrows & Taylor

Attorneys

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3,138,819

FLUID HEATER CLEANERS

William McColl, Lancaster, Ohio, assignor to Babcock & Wilcox Limited, London, England, a British company

Filed Feb. 9, 1961, Ser. No. 88,077
Claims priority, application Great Britain Feb. 9, 1960
2 Claims. (Cl. 15—317)

This invention relates to fluid heater cleaners of the kind having a long nozzle tube or lance, movable to advance the tube from and withdraw the tube to a retracted position and arranged during such movement to discharge cleaning fluid. With the increase in capacity and size of water tube steam boilers for central electricity generating stations, the length of the nozzle tubes of the fluid heater cleaners required for effective cleaning has also increased, and in some instances the design of a boiler has been disadvantageously dictated by the fact that blower tubes of desired length were not available.

It will be appreciated that conditions of operation normally prevent the use of nozzle tube supports within the gas space in which a nozzle tube is required to operate. As the nozzle tube is projected, therefore, more and more of the tube extends within the furnace chamber or gas pass, beyond its supporting means and finally, with a tube fully projected, it is supported only at one end thereof. The nozzle tube therefore tends to be highly stressed while subjected to high temperature conditions and conflicting design requirements arise. On the one hand, the diameter of the nozzle tube should be small in order to limit heat absorption and to obtain effective cooling through high rate of flow of cleaning fluid through the tube. Also for various reasons, it is desirable that the weight of the nozzle tube should be kept low. On the other hand, the diameter of the nozzle tube should be large in order to decrease deflection due to the force of gravity when the tube is projected. As a result of these conflicting requirements, the practicable length of a blower tube has been limited and an object of the invention is to render possible fluid heater cleaners with blower tubes of increased length.

In a fluid heater cleaner of the kind specified according to the present invention, the nozzle tube is provided at its forward end with nozzle means adapted when cleaning fluid is supplied to the tube to effect a cleaning fluid discharge that exerts a weight supporting upthrust.

Preferably the arrangement is such that when cleaning fluid is supplied at design pressure the upthrust is such that with the nozzle tube in a fully advanced position the deflection at the nozzle due to the upthrust is approximately equal and opposite to that due to the weight of the nozzle tube.

It will be appreciated that generally the nozzle tube will be supported outside the wall of a gas space within which the nozzle tube is arranged to operate, by suitable support means such as rollers adjacent the gas pass wall, and by carriage means for traversing the nozzle tube to or from its retracted position. When the nozzle tube is in its fully advanced position, the rear end thereof will be supported both by the support means and the carriage means which are not a perfect equivalent of a simple support. Consequently the weight supported by the upthrust due to the discharge of cleaning fluid to reduce the net deflection thereof substantially to zero will be less than one half the weight of the nozzle tube and generally equal to a weight of between three eighths and one half of the weight of the nozzle tube.

The invention will now be described, by way of example, with reference to the accompanying partly diagrammatic drawings, in which:

FIGURE 1 is a side elevation of a fluid heater cleaner or soot blower in extended position and projecting through a wall of a boiler gas pass into the gas pass, parts of the soot blower and associated support structure and gas pass being omitted to shorten the longitudinal extent of the view;

FIGURE 2 is a sectional side elevation of the nozzle tube support carriage and part of the supporting I-beam of FIGURE 1 to a larger scale than FIGURE 1;

FIGURE 3 is a side elevation to a larger scale than that of FIGURE 1 of the nozzle end of the soot blower nozzle tube;

FIGURE 4 is a section on the line 4—4 of FIGURE 3 viewed in the direction of the arrows;

FIGURE 5 is an end elevational view taken on the line 5—5 of FIGURE 1 viewed in the direction of the arrows, of the soot blower positioned in relation to spaced upright heat exchangers;

FIGURE 6 is a side elevation of modified support bearing means for the nozzle tube;

FIGURE 7 is a section taken on the line 7—7 of FIGURE 6 and viewed in the direction of the arrows;

FIGURE 8 is a side elevation similar to that of FIGURE 1 of a modified form of soot blower having ramps for rocking the nozzle tube;

FIGURE 9 is an end elevational view similar to that of FIGURE 5 of a pair of soot blowers positioned between spaced upright heat exchangers, and

FIGURE 10 is an end elevation similar to that of FIGURES 5 and 9 of a soot blower positioned between vertically spaced heat exchangers.

The soot blower of FIGURE 1 comprises a long nozzle tube 1 extending through an aperture 2 in a side wall 3 of a gas pass 4 of a boiler, and at its inner end is formed with a nozzle head 5 having nozzles indicated generally at 6 to be described in greater detail with reference to FIGURES 3 and 4. The nozzle tube 1 projects outwardly through the wall aperture 2 to a carriage 7 to which the nozzle tube is secured against relative longitudinal movement. The nozzle tube 1 is connected to the carriage 7 in the manner shown in FIGURE 2 in which the nozzle tube is connected in fluid-tight manner with a chamber 8 in the carriage body by means of a part spherical portion 9 on the rear end of the nozzle tube 1 seating between spaced annular packing rings 10 housed within a pressure member 26 and adapted to allow slight angular movement of the nozzle tube relative to the carriage such as may be occasioned by misalignment or deflection of the nozzle tube. Such connection serves to resist inadvertent rotation of the nozzle tube relative to the carriage 7 by means of a pin 9A secured to the carriage body engaging a slot 9B formed in a lower part of the spherical portion 9 but permits rocking thereof when a force due for example to slight bending of the nozzle tube, is applied greater than the friction between the packing rings 10 and the part spherical end 9 of the nozzle tube 1.

The carriage 7 is supported in well known manner from a lower flange 11 of a horizontal I-beam 12 extending normally and outwardly from the gas pass wall 3 and suitably supported from structural steelwork of the boiler. Thus the carriage 7 is provided with four sets 13 of rollers each set comprising an upper and a lower roller 13A and 13B, the upper roller 13A rolling on the upper surface of the flange 11 and the lower roller 13B rolling on the lower surface thereof. The sets 13 of rollers are disposed with a pair of sets on opposite sides of the web 14 of the beam 12 at the end of the carriage 7 nearer the wall 3, and a pair of sets on opposite sides of the web 14 at the end of the carriage 7 further from the wall 3.

At the outer of rear end of the beam 12 is mounted a cleaning fluid supply box 18 of known form having

an inlet 19 for the supply of cleaning fluid under the control of a valve 20 and the box 18 is provided with a fluid delivery tube 21 extending inwardly or forwardly therefrom, below the beam 12 and in axial alignment with the nozzle tube 1. The delivery tube 21 is telescopically arranged with respect to the nozzle tube 1 and to this end, as seen in FIGURE 2, has an outer diameter less than the inner diameter of the nozzle tube 1 so that the delivery tube 21 is a free fit within nozzle tube 1 and the part spherical end portion 9 thereof. The delivery tube 21 is slidably connected to the carriage 7 at a gland 22 therein and passes through the chamber 8 and into the nozzle tube 1 at the part spherical end portion 9 thereof.

The gland 22 comprises a flexible packing sleeve 23 disposed around the delivery tube 21 and compressed between pressure rings 24 and 25 freely slidable on the tube 21. The innermost of the pressure rings 25 is seated within a bore formed at the rear of the pressure member 26, the member 26 being formed internally with a retaining shoulder 27 for ring 25. The packing sleeve 23 is fitted within the bore, seating at its inner end against the pressure ring 25, and the pressure ring 24 slidably fits within the outer or rearward end of the bore, being urged inwardly by means of a gland nut 28 engaging a threaded rear portion 29 of the member 26. The member 26 is urged inwardly to compress packing rings 10 by means of gland nut 30 engaging a shoulder 31 on member 26 and having an internally threaded annular extension 32 engaging a threaded rear end portion 33 on the body of the carriage 7. In order to prevent rotation of member 26 relative to the body of carriage 7 a grub screw 34 is provided in the body of the carriage inwardly of threaded portion 33 and engaging a longitudinal slot 35 formed in member 26.

As seen in FIGURE 1, the nozzle tube 1 is supported adjacent the wall 3 by roller bearing means 36 disposed outside the gas pass and supported from the I-beam 12 adjacent its inner or forward end. The roller bearing means 36 comprise upper and lower rollers 37 arranged with their axes horizontal in a plane normal to the nozzle tube 1. The rollers 37 permit free longitudinal movement of the nozzle tube but tend to resist inadvertent rotation thereof and to this end they may be curved in longitudinal cross-section to engage the nozzle tube over an extended arcuate portion thereof. In an alternative, three straight cylindrical rollers are provided distributed equi-angularly around the nozzle tube 1 with the uppermost roller horizontal.

As seen more clearly in FIGURE 3, the end of the tube 1 is butt welded to the nozzle head 5 at its rear end as at 38, and the head 5 has an outer diameter substantially equal to that of the tube 1 and has an internal diameter corresponding to the internal diameter of tube 1. The tube 1 and nozzle head 5 are arranged so that internally and externally the surfaces of the nozzle head 5 and of the nozzle tube 1 are smoothly continuous in order to minimise interference with fluid flow.

The nozzle head 5 is formed with a closed forward end 39 of domed form and is provided with eight nozzles 6A, 6B, 6C, 6D, 6E, 6F, 6G and 6H each comprising a short cylinder extending radially inwards of the head 5 and connected at its outer end by welding in a corresponding aperture in the head 5. The nozzles are arranged in pairs of nozzles symmetrically disposed on opposite sides of a vertical plane through the nozzle tube axis. The nozzles 6A and 6B of a first pair have the largest bore and are directed downwardly at the steepest inclination, the nozzles 6G and 6H of a second pair have a somewhat smaller bore and are inclined upwardly at an inclination less steep than that of the first pair, the nozzles 6C and 6D of a third pair have a somewhat smaller bore than those of the second pair and are inclined downwardly at a smaller inclination than that of the second pair, and the nozzles 6E and 6F of a fourth pair have an equal bore to that of the nozzles of the third pair and are inclined upwardly at the smallest angle of inclination. The nozzles of the different pairs are respectively disposed with their axes in mutually spaced planes normal to the longitudinal axis of the nozzle tube 1, the nozzles 6A, 6C, 6E and 6G having their axes in a plane closer to the inner closed end 39 of the nozzle head 5, and the nozzles 6B, 6D, 6F and 6H having their axes in a plane further from the inner closed end of the nozzle head 5.

As seen in FIGURE 5 the nozzle head 5 is arranged, when the nozzle tube 1 is in projected position, to extend centrally between spaced upright tube banks 40 and 41, and to clean a vertical extent of each tube bank corresponding to the included angle between outer limits of the discharges indicated by chain dotted lines from the uppermost and the lowermost nozzles at the adjacent side of the nozzle head 5, such as the nozzles 6A and 6H. The nozzle head 5 is suitably spaced from the heat exchangers 40 and 41 by such a distance that at the heat exchangers the discharges from the adjacent nozzles of the nozzle head overlap.

In operation, the nozzle tube 1 is projected and retracted without being rotated and therefore the useless dissipation of cleaning fluid, normally steam, in the space between the spaced tube banks 40 and 41, is avoided. It will be appreciated that the driving motor 17 on the carriage 7 is suitably controlled by limit switches suitably mounted adjacent opposite ends of the beam 12 and adapted as the carriage reaches the extreme positions to effect reversal of rotation of the motor at the inner extreme position, and cessation of rotation of the motor at the outer extreme position.

As cleaning fluid is discharged through the nozzles at high velocity, it will be appreciated that discharges from the upper pair of nozzles 6H and 6G and the lower pair of nozzles 6A and 6B will be at greater rates than the discharges from the remaining nozzles owing to their larger bores. Since the nozzles of the upper and lower pairs are inclined more steeply than the other nozzles, the discharges therefrom have a greater distance to travel before contacting the heat exchanger surfaces and the increased rates of discharge serve to make more uniform the cleaning effect on the heat exchangers.

Since the sum of the cross-sectional areas of the nozzles directed downwardly is greater than the corresponding sum of the cross-sectional areas of the nozzles directed upwardly, the total momentum of the downward discharges will be greater than that of the upper discharges, and further, since the inclinations to the vertical of the downwardly directed nozzles 6A, 6B and 6C, 6D are less than the corresponding inclinations of the upwardly directed nozzles, downward vertical components of momentum of the downward discharges are greater than vertical components of momentum of the upward discharges. Consequently there is a net vertical reaction force on the nozzle head in an upward direction which effects a weight supporting upthrust. It will be appreciated that the nozzles being arranged in pairs having discharges with equal and oppositely directed horizontal components of momentum, horizontal components of momentum are balanced.

Suitably the delivery tube 21 is supplied with cleaning fluid at such pressure greater than the gas pressure within the pass 4, and the cross-sectional areas and inclinations of the nozzles are so selected, that in operation when the nozzle tube is in fully advanced position the weight supporting upthrust due to the reaction at the nozzle head 5 is such that the deflection at the nozzle due to the upthrust is approximately equal and opposite to that due to the weight of the nozzle tube 1. In these circumstances when the nozzle tube is fully extended, between one-half and five-eighths of its weight will be supported at the support bearing 36 and between three eighths and half

at the nozzle head 5, the nozzle tube 1 having substantially no deflection, due to its weight, at the nozzle head 5 which will be at substantially the same level as the outer or rear end of the nozzle tube 1 at weight support bearing 36. There will be a maximum deflection or sag of the nozzle tube at a location between its mid-point and five-eighths of its length from the support bearing, but this deflection will be much less than the maximum deflection which would exist at the nozzle head 5 if there were no weight supporting upthrust. Furthermore, the weight supporting upthrust serves to reduce the loading on the support bearing 36 and the structural steel work to a small value relative to the load which would be exerted by the nozzle tube 1 when in fully projected position if there were no weight supporting upthrust. The maximum force that the bearing means are required to withstand is a direct loading of between half and five eighths of the nozzle tube weight instead of the force due to the leverage of a nozzle tube supported as a cantilever.

It is an advantage of the nozzle head described that owing to the relatively large number of discharge nozzles, the rate of discharge of cleaning fluid and the velocity of flow of the fluid through the nozzle tube 1 are high, with the result that the nozzle tube 1 is effectively cooled. Since the cleaning fluid is discharged at high rate and through a number of relatively angularly distributed nozzles 6A to 6H, the projection and retraction of the nozzle tube can be effected relatively rapidly and this is advantageous in that a fluid heater cleaning operation entailing the operation of a number of cleaners in sequence may be more expeditously effected while the nozzle tube is subjected for a shorter time to the furnace gases.

In a preferred form of the invention, provision is made for rocking the nozzle tube about its longitudinal axis through a small angle in order to increase the area of heat exchanger surface which the cleaner is able to clean. In a particular arrangement provision is made for rocking the nozzle tube 1 when in or adjacent its extreme positions through an angle of 18° and to this end, as shown in FIGURES 6 and 7, a modified form of support bearing is employed and as shown in FIGURE 8 forward and rearward cams or ramps are adapted to engage complementary means on the carriage 7 to effect the desired rocking as under the control of motor 17 actuating the carriage 7, the nozzle tube approaches its extreme advanced and retracted positions. To allow rocking of the nozzle tube relative to the carriage 7, the pin 9A is omitted so that the nozzle tube may rock by rotational slipping of the end portion 9 in the seating members 10.

In FIGURES 6 and 7 the modified support bearing comprises an horizontal roller 41 disposed below the nozzle tube 1 and normally with respect to the longitudinal axis thereof. The roller 41 is of waisted cross-section having an arcuate contact periphery 42 arranged to contact the nozzle tube 1 over a substantial part of its periphery on opposite sides of a vertical centre line and thereby reduce any tendency for the nozzle tube 1 to rotate by slipping relative to the roller 41. The roller 41 is rotatably supported on an horizontal shaft 43 by spaced ball bearings 44, the shaft 43 being supported at its ends in spaced upright support members 45 and being in the form of a bolt having a locked nut 46 retaining it in position. The support members 45 extend downwardly below roller 41 and are rigidly secured adjacent their lower ends to a spacer 47 by welds 48. Outer faces of the support members 45 adjacent lower parts thereof support elongated bearing blocks 49 of square cross-section and formed with respective central bores 50 parallel to the axis of nozzle tube 1. The blocks 49 receive spindles 51 through the bores 50, the splindles projecting at opposite ends of the blocks 49 where they carry rollers 52 of diameter less than the diagonal length of the cross-section of the blocks 49. Outwardly of the rollers 52 the spindles 51 carry retaining washers 53 of larger outer diameter than that of the rollers 52, the washers being held on respective spindles at one end by an enlargement 54 and at the other end by a locked nut 55. The rollers 52 are movable in respective arcuate slots 56 centred at the longitudinal axis of the nozzle tube 1 and formed in front and rear support plates 57 and 58.

The support plates 57 and 58 are of generally sector shape with their apices uppermost and arcuate portions lowermost and are held in spaced upright relationship by upper and lower spacer members 59 and 60 welded to the plates, and an upright support member 61 is secured to the upper spacer member 59 and projects upwardly therefrom for securement by suitable means such as bolts to the I-beam on which the carriage of the nozzle tube is arranged to run. The plates 57 and 58 are provided with respective, aligned apertures 62 and 63 of larger diameter than the outer diameter of nozzle tube 1, through which apertures the nozzle tube 1 passes, the tube resting intermediate the plates 57 and 58 on the roller 41. Each of the plates 57 and 58 is provided with a pair of arcuate slots 56 at opposite sides of and equi-angularly displaced from a central position, the slots 56 receiving respective rollers 52 and being arranged to permit angular movement of the nozzle tube by rolling of rollers 52 in the slots 56 through the desired angle of rocking. The square cross-section bearing blocks 49 and the retaining washers 53 serve to maintain the rollers 52 correctly in position within the slots 56 throughout the full range of their movement.

Referring now to FIGURE 8, adjacent and outwardly of the wall 3, a cam in the form of a ramp 64 is rigidly supported from the I-beam 12 by spaced upright members 65 and 66 which are of suitable inverted L shape in cross-section, with the horizontal limbs 65A and 66A welded to the upper surface of the I-beam 12 and the upright limb 65B and 66B spaced sidewardly of the nozzle tube 1 sufficiently to allow forward movement of the carriage 7 without interference therewith. The limbs 65B and 66B are provided adjacent their lower ends with upright slots 65C and 66C receiving respective bolts passing through corresponding apertures 65D and 66D formed in the ramp 64, the bolts being provided with nuts for clamping the ramp 64 in adjusted position relative to the members 65 and 66, and the apertures 65D and 66D being suitably enlarged to allow adjustment of the inclination of the ramp 64 whilst sliding the bolts in the upright slots 65C and 66C. The ramp 64 is arranged with the uppermost part at the end thereof adjacent the wall 3 and substantially at the level of the longitudinal axis of the nozzle tube 1, and slopes downwardly away from the wall to a level below the nozzle tube 1. A similar ramp 67 is provided adjacent the outer end of the I-beam 12 and inwardly of the extreme outer or rearmost position of the carriage 7. This ramp 67 is inverted compared with the ramp 60 and extends upwardly from a lowermost part adjacent the rearmost extreme position of the carriage 7 at a level substantially the same as that of the longitudinal axis of the nozzle tube 1 upwardly towards the wall to a location above the nozzle tube 1. The ramp 67 is supported in a similar manner to the ramp 64 by support members, not shown.

A roller 68 supported from the nozzle tube 1 inwardly of the carriage 7 by bracket means 69 projects sidewardly from the nozzle tube and is arranged to engage the upper surface of the ramp 64 and the lower surface of the ramp 67 so that on forward movement of the carriage past the ramp 67 and continued forward movement as indicated by arrows 68A until the roller 68 reaches the lower end of ramp 64 the nozzle tube is projected without rocking. When near the end of the projection of the nozzle tube, the roller 68 engages the lower end of ramp 64 the carriage continues to move forwards and urges the roller 68 up the ramp 64, as indicated by arrows 68B, causing upward movement of the roller and consequent rocking of the nozzle tube by rotational slipping at the spherical

end portion 9, as seen in FIGURE 2, of the nozzle tube in its seating 10. Rocking continues until the carriage 7 reaches a forward limit of travel defined by a forward stop 70 mounted on the lower flange 11 of the I-beam 12 and arranged to engage a forward support wheel 13A of the carriage. On rearward movement of the carriage 7 from its extreme forward position the nozzle tube 1 is withdrawn without rocking, as indicated by arrows 68C, until near the end of the retraction of the nozzle tube the roller 68 engages the upper end of the rearward ramp 67. On continued rearward movement of the carriage 7 the roller 68 is urged downwards, as indicated by arrow 68D, causing rocking of the nozzle tube 1 in a reverse direction to that occasioned at the forward ramp 64 until the nozzle tube 1 is in an initial position corresponding to engagement of a rearward carriage support wheel 13A by a rear stop 71. On subsequent forward movement of the carriage 7 occasioned by a further cleaning operation the above described sequence is repeated, the nozzle tube 1 moving forwardly without rocking until the roller 68 engages the lower end of the forward ramp 64.

It will be appreciated that the inclination and length of each of the ramps 64 and 67 is chosen so that the desired angle of rocking is effected and also it will be appreciated that the rate at which the nozzle tube 1 is rocked may be made more gradual by reducing the inclinations of the ramps. The rearward ramp 67 is so positioned that with rear support wheel 13A of the carriage in engagement with the rearward stop 71 the nozzle tube 1 has been turned back to an initial position corresponding to one limit of the angle through which it is desired to rock the nozzle tube 1 and the upper end of the forward ramp is positioned so that when the forward stop 70 engages the associated forward support wheel 13A of the carriage the nozzle tube 1 has been rocked to the other limit of the desired angle.

When more than one fluid heater cleaner is to clean a pair of adjacent tube banks, the nozzle tubes thereof are suitably positioned so as to ensure cleaning of substantially the whole of the heat exchange surfaces served by those fluid heater cleaners. Thus, as seen in FIGURE 9, spaced upright tube banks 72 and 73 are served by spaced nozzle tubes 74 and 75 arranged to extend between the tube banks. The lower nozzle tube 75 is arranged to rock through a small angle such that limits of the zones of the tube banks cleaned on a forward traverse of the nozzle tube are shown by the dotted lines 76 whilst the zones cleaned on a rearward traverse of the nozzle tube are shown by the chain dotted lines 77. Dotted lines 78 and chain dotted lines 79 represent corresponding zones cleaned by the upper nozzle tube 74. The lower cleaner 75 is arranged so that on forward traverse its discharge reaches the lowermost portion of one tube bank 73 whilst on rearward traverse after rocking through a small angle its discharge reaches the lowermost portion of the other tube bank 72. The upper nozzle tube 74 is arranged so that on forward traverse the discharge of cleaning fluid at the side of tube bank 72 intersects the discharge from the cleaner 75, as indicated by the intersection between broken lines 78 and 76, at the side of tube bank 72 and so that on rearward traverse, after rocking through a small angle, the discharge therefrom on the other side overlaps the corresponding discharge from the lower cleaner 75 at the side of the heat exchanger 73 as indicated by intersection between chain dotted lines 77 and 79.

It will be understood that sufficient vertically spaced cleaners may be arranged in this way so that the full vertical coverage of the heat exchangers is provided without unnecessary waste of cleaning fluid.

In the arrangement of FIGURE 10 a nozzle tube 80 of the nature similar to that described in connection with FIGURES 1 to 4, but with a suitably modified form of nozzle head, and adapted for rocking as described in connection with FIGURES 6 to 8 is positioned horizontally for traverse between spaced horizontal tube banks 81 and 82 arranged in a gas pass 83.

It will be appreciated that the discharges with greater horizontal components of momentum will have to travel greater distances to the surfaces to be cleaned than the discharges with lesser horizontal components and to this end the nozzles of larger bore will be intermediate uppermost and lowermost nozzles of smaller bore. Thus the nozzle head of FIGURES 3 and 4 will be modified such that nozzles 6A, 6B, 6G and 6H change positions with nozzles 6C, 6D, 6E and 6F respectively.

The nozzle tube 80 is disposed nearer to the upper heat exchanger 82 than to the lower heat exchanger 81 and since the vertical momentum of the upward discharges is lower than that of the downward discharges this tends to equalise the cleaning effect of the upper and lower discharges. The nozzle tube 80 is disposed centrally of the width of the gas pass and arranged so that at one limit of rocking the downward discharges reach the end of the lower tube bank 81 at one side of the pass 83, whilst the upward discharges reach an end of the upper tube bank 82 at the other side of the pass 83, as indicated by broken lines 81A and 82A respectively. The angle of rocking is so selected that on rocking the nozzle tube 80 to the other limit, the downward discharge at its other side limit, as indicated by chain dotted line 81B, just reaches the end of the lower tube bank at the said other side of the gas pass, whilst the other side limit of the upward discharge just reaches the end of the upper tube bank 82 at the said one side of the gas pass 83.

Thus, in operation, forward traverse of the nozzle tube at one limit of the angle of rocking and rearward traverse at the other limit of rocking suffices to ensure the upper and lower tube banks are subjected to cleaning fluid discharge over the full width of the gas pass without unnecessary waste of cleaning fluid in parts of the pass 83 not containing heat exchanger tube surfaces.

I claim:

1. A fluid heater cleaner adapted to operate in a hot gas pass and having a cleaning fluid supply tube, an elongated nozzle tube telescopically arranged with respect to the cleaning fluid supply tube and formed at a forward end with nozzle means adapted when the nozzle tube is supplied with the cleaning fluid to effect a cleaning fluid discharge which exerts on the said end of the nozzle tube a weight supporting upthrust, track means, carriage means movable along and supported by said track means, first support means connecting said carriage means to the rear end of the nozzle tube and permitting rotational movement of the nozzle tube relative to the carriage means, additional support means supporting the nozzle tube intermediate its forward and rear ends, said nozzle tube being movable relatively to the additional support means between a withdrawn position and an advanced position, first cam means located in a position to be adjacent the rear end of the nozzle tube when said nozzle tube is in its advanced position, second cam means located in a position to be adjacent the rear end of said nozzle tube when said nozzle tube is in its withdrawn position, and cam follower means mounted on said nozzle tube adjacent its rear end arranged to coact with said cam means so that during termination of movement of said nozzle tube to the advanced position engagement of the cam follower with the first cam means causes rocking of the nozzle tube through a limited angle about its longitudinal axis in one sense and during termination of movement of said nozzle tube to the withdrawn position engagement of the cam follower with the second cam means causes rocking of the nozzle tube through an equal angle in the reverse sense.

2. A fluid heater cleaner as claimed in claim 1, in which said additional support means for the nozzle tube

comprises a concave roller adapted to support the nozzle tube over a substantial part of its periphery, said roller being supported on a carrier formed of support plates, said carrier being suspended from said track means, each of said support plates having a pair of arcuate slots at opposite sides of and equiangularly displaced with respect to the axis of the nozzle tube, additional rollers respectively located within respective slots adapted to permit angular movement of the nozzle tube by rolling of said rollers in said slots through the desired angle of rocking.

References Cited in the file of this patent

UNITED STATES PATENTS

1,010,028	Davies	Nov. 28, 1911
1,033,195	Robinson	July 23, 1912
1,599,283	Phillips	Sept. 7, 1926
2,167,194	Anderson	July 25, 1939
2,604,358	Richards	July 22, 1952
2,668,978	De Mart	Feb. 16, 1954

FOREIGN PATENTS

98	Great Britain	Jan. 1, 1906